Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) A method for causing motion of particles in a medium, the method comprising:

applying a time-varying driving field to the particles, the driving field applying a time-varying driving force alternating in direction to the particles; and,

applying a mobility-varying field to the particles, the mobility-varying field being one or both of: different in type from the driving field, and non-aligned with the driving field;

wherein the driving field and mobility-varying field are applied simultaneously during a period and the mobility-varying field causes a mobility of the particles in the medium to be time dependent during the period, in a manner having a non-zero correlation with the driving field over the period.

2. (Original) A method according to claim 1 wherein the driving field applies a periodically varying driving force to the particles.

3. (Original) A method according to claim 2 wherein the driving force averages to zero over an integral number of cycles of the driving field.

4. (Currently Amended) A method according to claim 2 [[or 3]] wherein the mobility-varying field causes the mobility of the particles to vary periodically.

5. (Original) A method according to claim 4 wherein the driving force and the varying mobility of the particles have a substantially constant phase relationship.

6. (Currently Amended) A method according to ~~any one of claims 1 to 5~~ claim 1 wherein applying the driving field to the particles in the absence of the mobility-varying field results in no net motion of the particles.

7. (Currently Amended) A method according to ~~any one of claims 1 to 6~~ claim 1 wherein applying the mobility-varying field to the particles in the absence of the driving field results in no net motion of the particles.

8. (Currently Amended) A method according to ~~any one of claims 1 to 5~~ claim 1 wherein the particles have a velocity, v, resulting from the application of the driving field and the mobility-varying field together and v differs from the sum of the particle velocities that would result from the application of the driving field and the mobility-varying field independently.

9. (Currently Amended) A method according to ~~any one of claims 1 to 7~~ claim 1 wherein the correlation is non-zero when computed according to:

$$C_{f(t),g(t)} = \int_T f(t)g(t+\lambda)dt$$

where f(t) is the variation in driving force with time, g(t) is the variation in the mobility of the particles with time and λ is a constant time shift, for some value of λ and T is the period.

10. (Currently Amended) A method according to claim 2 [[or 3]] wherein the driving force varies sinusoidally in time.

11. (Currently Amended) A method according to ~~any one of claims 1 to 10~~ claim 1 wherein the driving field and mobility-varying fields are both of the same type.

12. (Currently Amended) A method according to ~~any one of claims 1 to 10~~ claim 1 wherein the driving field and mobility-varying ~~fields~~ field are of different types.

13. (Currently Amended) A method according to claim 11 [[or 12]] wherein the driving field comprises a time-varying electric field.

14. (Original) A method according to claim 13 wherein the particles comprise electrically charged molecules.

15. (Original) A method according to claim 13 wherein each of the particles comprises an electrically neutral particle bonded to an electrically charged particle.

16. (Original) A method according to claim 13 wherein the particles have dielectric constants different from that of the medium and the electric field has a time-varying gradient.

17. (Currently Amended) A method according to claim 11 [[or 12]] wherein the driving field comprises a time-varying magnetic field.

18. (Cancelled)

19. (Cancelled)

20. (Currently Amended) A method according to claim [[18]] 17 wherein the particles have magnetic susceptibilities different from that of the medium and the magnetic field has a time-varying gradient.

21. (Currently Amended) A method according to claim [[11]] 12 wherein the driving field comprises a time-varying flow in the medium.

22. (Currently Amended) A method according to claim [[11]] 12 wherein the driving field comprises a time-varying density gradient of [[some]] a species in the medium.

23. (Currently Amended) A method according to claim [[11 or]] 12 wherein the driving field comprises a time-varying gravitational or acceleration field.

24. (Original) A method according to claim 23 comprising accelerating the medium and periodically changing an orientation of the medium relative to a direction of the acceleration.

25. (Currently Amended) A method according to claim [[11 or]] 12 wherein the driving field comprises an acoustic field.

26. (Original) A method according to claim [[12]] 1 wherein the particles comprise living organisms.

27. (Original) A method according to claim 1 wherein the driving field comprises an alternating electric field aligned in a first direction.

28. (Original) A method according to claim 27 wherein the velocity of the particles is a non-linear function of applied electric field and the mobility-varying field comprises an electric field having an alternating component transverse to the first direction.

29. (Currently Amended) A method according to claim 27 [[or 28]] wherein the force applied by the driving field varies with a first frequency; the mobility-varying field varies in time with a second frequency; and the first frequency is twice the second frequency.

30. (Currently Amended) A method according to ~~any one of claims 1 to 29~~ claim 1 wherein applying the mobility-varying field causes changes in a conformation of the particles.

31. (Currently Amended) A method according to ~~any one of claims 1 to 29~~ claim 1 wherein applying the mobility-varying field causes changes in a viscosity of the medium.

32. (Currently Amended) A method according to ~~any one of claims 12 to 26~~ claim 12 wherein applying the mobility-varying field comprises changing a temperature of the medium.

33. (Currently Amended) A method according to ~~any one of claims 12 to 26~~ claim 12 wherein applying the mobility-varying field comprises exposing the particles to electromagnetic radiation wherein one or more of an intensity, polarization or wavelength of the radiation varies in time ~~with the driving field~~.

34. (Currently Amended) A method according to ~~any one of claims 11 to 26~~ claim 1 wherein applying the mobility-varying field comprises applying an electric field to at least the portion of the medium through which the particles are passing.

35. (Currently Amended) A method according to ~~any one of claims 11 to 26~~ claim 1 wherein applying the mobility-varying field comprises applying a magnetic field to the medium through which the particles are passing.

36. (Cancelled)

37. (Cancelled)

38. (Currently Amended) A method according to ~~any one of claims 12 to 26~~ claim 12 comprising causing particles to travel in the medium along a surface wherein applying the mobility-varying force alters an interaction between the particles and the surface.

39. (Cancelled)

40. (Cancelled)

41. (Cancelled)

42. (Currently Amended) A method according to ~~any one of claims 12 to 26~~ claim 12 wherein applying the mobility-varying field comprises causing cyclic chemical changes in the medium.

43. (Currently Amended) A method according to ~~any one of claims 12 to 26~~ claim 12 wherein applying the mobility-varying field comprises causing the particles to cyclically bind and unbind to other particles in the medium.

44. (Currently Amended) A method according to ~~any one of claims 12 to 26~~ claim 12 wherein applying the mobility-varying field comprises causing the particles to cyclically bind and unbind to a component of the medium.

45. (Currently Amended) A method according to ~~any one of claims 12 to 26~~ claim 12 wherein applying the mobility-varying field comprises varying a hydrostatic pressure experienced by the medium.

46. (Currently Amended) A method according to ~~any one of claims 12 to 26~~ claim 12 comprising allowing the particles to pass through an area of the medium having a physical dimension on the order of a dimension of the particles wherein applying the mobility-varying field comprises varying the physical

~~dimensions~~ dimension of the area of the medium to cause a change in an effective drag experienced by the particles in the area of the medium.

47. (Original) A method according to claim 32 wherein applying the mobility-varying field comprises directing radiation at at least a portion of the medium and allowing the radiation to be absorbed in the medium.

48. (Cancelled)

49. (Cancelled)

50. (Original) A method according to claim 32 wherein the particles have an electromagnetic absorption band and wherein applying the mobility-varying field comprises directing radiation having a wavelength in the electromagnetic absorption band at the particles.

51. (Original) A method according to claim 33 wherein the particles comprise a component that undergoes a reversible change in conformation in response to the radiation.

52. (Currently Amended) A method according to claim 33 wherein the particles ~~comprise DNA~~ are bonded to molecules that ~~undergoes~~ undergo a reversible change in conformation in response to the radiation.

53. (Cancelled)

54. (Cancelled)

55. (Original) A method according to claim 33 wherein applying the electromagnetic radiation causes partial cross-linking of polymers in the medium.

56. (Original) A method according to claim 33 wherein the radiation directly affects the mobility of the particles in the medium.

57. (Cancelled)

58. (Cancelled)

59. (Cancelled)

60. (Cancelled)

61. (Original) A method according to claim 42 wherein the chemical changes alter binding of the particles to one another.

62. (Original) A method according to claim 42 wherein the chemical changes alter binding of the particles to other species or structures in the medium.

63. (Original) A method according to claim 42 wherein the chemical changes alter binding of species in the medium to one another.

64. (Original) A method according to claim 42 wherein the chemical changes alter a viscosity of the medium.

65. (Original) A method according to claim 42 comprising causing the chemical changes by applying optical radiation to the medium.

66. (Cancelled)

67. (Cancelled)

68. (Original) A method according to claim 42 comprising inducing the chemical changes by introducing chemical species into the medium.

69. (Original) A method according to claim 42 wherein the chemical changes alter a pH of the medium.

70. (Original) A method according to claim 35 wherein the medium comprises ferromagnetic particles and applying the magnetic field causes the feromagnetic particles to be pulled away or into a path of the particles.

71. (Original) A method according to claim 35 wherein applying the magnetic field comprises causing a viscosity of the medium to vary in a two-dimensional pattern.

72. (Original) A method according to claim 71 wherein the medium comprises magnetic particles wherein applying the magnetic field causes the magnetic particles of the medium to aggregate with one another.

73. (Original) A method according to claim 35 wherein applying the magnetic field causes the particles to be drawn toward or moved away from a drag-inducing surface.

74. (Original) A method according to claim 27 wherein the mobility-varying field comprises an electric field having an alternating component transverse to the first direction.

75. (Original) A method according to claim 74 wherein applying the electric mobility-varying field causes the particles to be drawn toward or moved away from a drag-inducing surface.

76. (Original) A method according to claim 35 wherein applying the magnetic field causes the particles to aggregate.

77. (Currently Amended) A method according to ~~any of claims 1 to 76~~ claim 1 wherein the particles comprise biomacromolecules.

78. (Original) A method according to claim 77 wherein the biomacromolecules are electrically charged.

79. (Original) A method according to claim 77 wherein the biomacromolecules are electrically neutral.

80. (Currently Amended) A method according to ~~any one of claims 77 to 79~~ claim 77 wherein the biomacromolecules comprise proteins.

81. (Currently Amended) A method according to ~~any one of claims 77 to 79~~ claim 77 wherein the biomacromolecules comprise RNA.

82. (Currently Amended) A method according to ~~any one of claims 77 to 79~~ claim 77 wherein the biomacromolecules comprise DNA.

83. (Cancelled)

84. (Currently Amended) A method according to ~~any one of claims 77 to 79~~ claim 77 wherein the biomacromolecules comprise polymers.

85. (Currently Amended) A method according to ~~any one of claims 77 to 79~~ claim 77 wherein the biomacromolecules comprise polypeptides.

86. (Currently Amended) A method according to ~~any one of claims 1 to 76~~ claim 1 wherein the particles comprise aggregations of molecules.

87. (Original) A method according to claim 86 wherein the aggregations comprise micelles.

88. (Currently Amended) A method according to ~~any one of claims 1 to 87~~ claim 1 wherein the medium comprises a gel.

89. (Original) A method according to claim 88 wherein the gel comprises an agarose gel.

90. (Currently Amended) A method according to ~~any one of claims 1 to 87~~ claim 1 wherein the medium comprises a liquid solution of polymers.

91. (Currently Amended) A method according to ~~any one of claims 1 to 87~~ claim 1 wherein the medium comprises binding sites ~~designed to~~ that bind to the particles.

92. (Currently Amended) A method according to ~~any one of claims 1 to 87~~ claim 1 wherein the medium comprises acrylamide or poly-acrylamide.

93. (Currently Amended) A method according to ~~any one of claims 1 to 87~~ claim 1 wherein the medium comprises a microfabricated array of posts.

94. (Currently Amended) A method according to ~~any one of claims 1 to 87~~ claim 1 comprising allowing the particles to interact with the medium by entropic trapping.

95. (Currently Amended) A method according to ~~any one of claims 1 to 94~~ claim 1 wherein the particles are substantially constrained to move on a ~~2D~~ two-dimensional surface.

96. (Currently Amended) A method according to claim 95 wherein the [[2D]] two-dimensional surface comprises a thin layer of the medium.

97. (Currently Amended) A method according to ~~any one of claims 1 to 95~~ claim 1 wherein the medium has a three dimensional extent and the method comprises concentrating the particles at a location in the medium by periodically changing a plane of the driving force.

98. (Currently Amended) A method according to ~~any one of claims 1 to 97~~ claim 1 wherein the medium comprises a first part and a second part, and the method comprises applying a first mobility-varying field in the first part and a second mobility-varying field in the second part, wherein the driving field and the first mobility-varying field cause particles in the first part to move toward the second part and wherein the driving field and second mobility-varying field cause particles in the second part to move toward the first part.

99. (Original) A method according to claim 1 wherein applying the driving field and applying the mobility-varying field comprise applying two independent time-varying electric fields to the medium containing the particles.

100. (Original) A method according to claim 99 wherein, at the particles, the two independent electric fields are not aligned with one another during at least a portion of the period.

101. (Currently Amended) A method according to ~~any one of claims 99 to 100~~ claim 99 wherein the first electric field approximates a dipole field within an area of the medium.

102. (Currently Amended) A method according to ~~any one of claims 99 to 101~~ claim 101 wherein the second electric field approximates a quadrupole field in the area of the medium.

103. (Currently Amended) A method according to ~~any one of claims 99 to 102~~ claim 99 wherein the time variation of the first

electric field constitutes a rotation of the first electric field about a location in the area of the medium.

104. (Currently Amended) A method according to ~~any one of claims 99 to 103~~ claim 99 wherein the time variation of the second electric field constitutes a rotation of the second electric field about a location in the area of the medium.

105. (Currently Amended) A method according to ~~any one of claims 99 to 102~~ claim 99 wherein the time variation of the first electric field constitutes a rotation of the first electric field about a location in the area of the medium at a first angular frequency and the time variation of the second electric field constitutes a rotation of the second electric field about a location in the area of the medium at a second angular frequency, wherein the second angular frequency is twice the first angular frequency.

106. (Currently Amended) A method according to ~~any one of claims 1 to 105~~ claim 1 wherein the medium constitutes a first medium and the method comprises subsequently extracting the particles from the first medium by an extraction method comprising:

providing a second medium adjoining the first medium at an interface wherein, in the second medium, the particles have velocities that vary substantially linearly with an intensity of an extraction driving field;

for a plurality of extraction periods, in alternation:

for a first part of an extraction period, applying a first extraction driving field directed across the interface, the first extraction driving field causing

the particles in the first medium to move toward the interface by a first distance during the first part of the extraction period;

for a second part of the extraction period, applying a second extraction driving field across the interface, the second extraction driving field having an intensity different from the first extraction driving field and causing the particles in the first medium to move away from the interface by a second distance less than the first distance during the second part of the extraction period;

allowing the particles to cross the interface into the second medium.

107. (Original) A method according to claim 106 comprising allowing the particles to become concentrated in the second medium.

108. (Currently Amended) A method according to ~~cone of claims 106 and 107~~ claim 106 wherein the second medium comprises a buffer solution.

109. (Currently Amended) A method according to ~~one of claims 106 to 108~~ claim 106 comprising sucking the second medium containing the particles into a transfer device.

110. (Currently Amended) A method according to ~~any one of claims 1 to 105~~ claim 1 wherein the medium constitutes a first medium and the method comprises subsequently extracting the particles from the first medium into a second medium by an extraction method comprising:

during an extraction period applying a time-varying extraction driving field and a time-varying extraction mobility-varying field to the particles, the extraction driving field applying a time-varying extraction driving force to the particles the extraction driving force alternating in direction and directed across the interface;

the extraction mobility-varying field causing a mobility of the particles in the first medium to vary during the period, in a manner having a non-zero correlation with the driving field over the period such that particles in the first medium drift toward the interface with a first net velocity until the particles enter the second medium.

111. (Original) A method according to claim 110 comprising applying the extraction mobility-varying field only to the first medium so that the particles have a net drift velocity in the second medium that is significantly less than the first drift velocity or zero.

112. (Original) A method according to claim 110 wherein the extraction mobility-varying field does not significantly affect the mobility of the particles in the second medium.

113. (Cancelled)

114. (Cancelled)

115. (Cancelled)

116. (Cancelled)

117. (Cancelled)

118. (Cancelled)

119. (Cancelled)

120. (Cancelled)

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122. (Cancelled)

123. (Cancelled)

124. (Cancelled)

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133. (Cancelled)

134. (Cancelled)

135. (Cancelled)

136. (Cancelled)

137. (Cancelled)

138. (Cancelled)

139. (Cancelled)

140. (Cancelled)

141. (Original) Apparatus for concentrating particles, the apparatus comprising:

a body of a medium in which the particles are mobile;

a first field source coupled to deliver a time-varying driving field to the medium the driving field capable of applying a time-varying driving force alternating in direction to particles in the medium; and,

a second field source coupled to deliver a time-varying mobility-varying field to the medium, the mobility-varying field being one or both of: different in type from the driving field, and non-aligned with the driving field; and,

a control system configured to apply the driving field and mobility-varying field simultaneously to at least a portion of the medium during a period.

142. (Original) Apparatus according to claim 141 wherein the body of the medium comprises a thin layer.

143. (Original) Apparatus according to claim 141 comprising an extended electrode maintained at a substantially constant potential on either side of the thin layer.

144. (Currently Amended) Apparatus according to ~~any one of claims 141 to 143~~ claim 141 wherein the medium comprises a gel.

145. (Original) Apparatus according to claim 144 wherein the gel comprises an agarose gel.

146. (Currently Amended) Apparatus according to ~~any one of claims 141 to 145~~ claim 141 wherein the medium comprises binding sites that selectively bind to the particles.

147. (Original) Apparatus according to claim 146 wherein the selective binding sites comprise sequences of nucleic acids that are complementary to nucleic acid sequences occurring in the particles.

148. (Currently Amended) Apparatus according to ~~any one of claims 141 to 147~~ claim 141 wherein the first field source comprises three or more non-collinear electrodes and a power supply controlled by the control system to apply a sequence of voltage patterns to the electrodes.

149. (Currently Amended) Apparatus according to ~~any one of claims 141 to 148~~ claim 141 wherein the second field source

comprises a heater connected to vary a temperature of the medium in time with a time-variation of the driving force.

150. (Currently Amended) Apparatus according to ~~any one of claims 141 to 148~~ claim 141 wherein the second field source comprises a source of a magnetic field.

151. (Currently Amended) Apparatus according to ~~any one of claims 141 to 148~~ claim 141 wherein the second field source comprises a source of electromagnetic radiation.

152. (Original) Apparatus according to claim 151 wherein the source of electromagnetic radiation comprises a source of light.

153. (Original) Apparatus according to claim 152 wherein the source of light is configured to illuminate the medium with a pattern of alternating lighter and darker areas.

154. (Cancelled)

155. (Cancelled)

156. (Cancelled)

157. (Cancelled)

158. (Cancelled)

159. (Cancelled)

160. (Cancelled)

161. (Cancelled)

162. (Currently Amended) Apparatus according to ~~any one of claims 141 to 148~~ claim 141 wherein the second field source comprises a source of an acoustic field.

163. (Cancelled)

164. (Original) Apparatus according to claim 163 wherein the medium is enclosed in a chamber and the apparatus comprises a means for reducing a pressure within the chamber.

165. (Currently Amended) Apparatus according to ~~any one of claims 141 to 164~~ claim 141 comprising a cooler in thermal contact with the medium.

166. (Cancelled)

167. (Cancelled)

168. (Cancelled)

169. (Cancelled)

170. (Cancelled)

171. (Cancelled)

172. (Cancelled)

173. (Cancelled)

174. (Cancelled)

175. (Cancelled)

176. (Cancelled)

177. (Cancelled)

178. (Cancelled)

179. (Cancelled)

180. (Cancelled)

181. (Cancelled)

182. (Original) Apparatus for causing motion of particles in a medium, the apparatus comprising:

a first means for applying a time-varying driving field to the particles, the driving field applying a time-varying driving force alternating in direction to the particles; and,

a second means for applying a mobility-varying field to the particles, the mobility-varying field being one or both of: different in type from the driving field, and non-aligned with the driving field;

a means for operating the first and second means in a coordinated manner so that the driving field and mobility-varying field are applied simultaneously during a period and

the mobility-varying field causes a mobility of the particles in the medium to be time dependent during the period, in a manner having a non-zero correlation with the driving field over the period.

183. (Cancelled)

184. (Cancelled)

185. (New) A method according to claim 21 wherein the mobility-varying field comprises an electrical field.

186. (New) A method according to claim 185 wherein the time-varying flow varies spatially and the electrical mobility-varying field alters effective mobilities of charged particles by moving the charged particles between regions having different rates of flow.